

# Early Conclusions of the Soil Moisture Active Passive Marena Oklahoma In Situ Sensor Testbed (SMAP-MOISST)

Michael H. Cosh<sup>1</sup>, Tyson Ochsner<sup>2</sup>, and Lynn McKee<sup>1</sup>

<sup>1</sup>USDA ARS Hydrology And Remote Sensing Laboratory, Beltsville, MD 20705 USA

<sup>2</sup>Plant And Soil Sciences, Oklahoma State University, Stillwater, OK 74078 USA

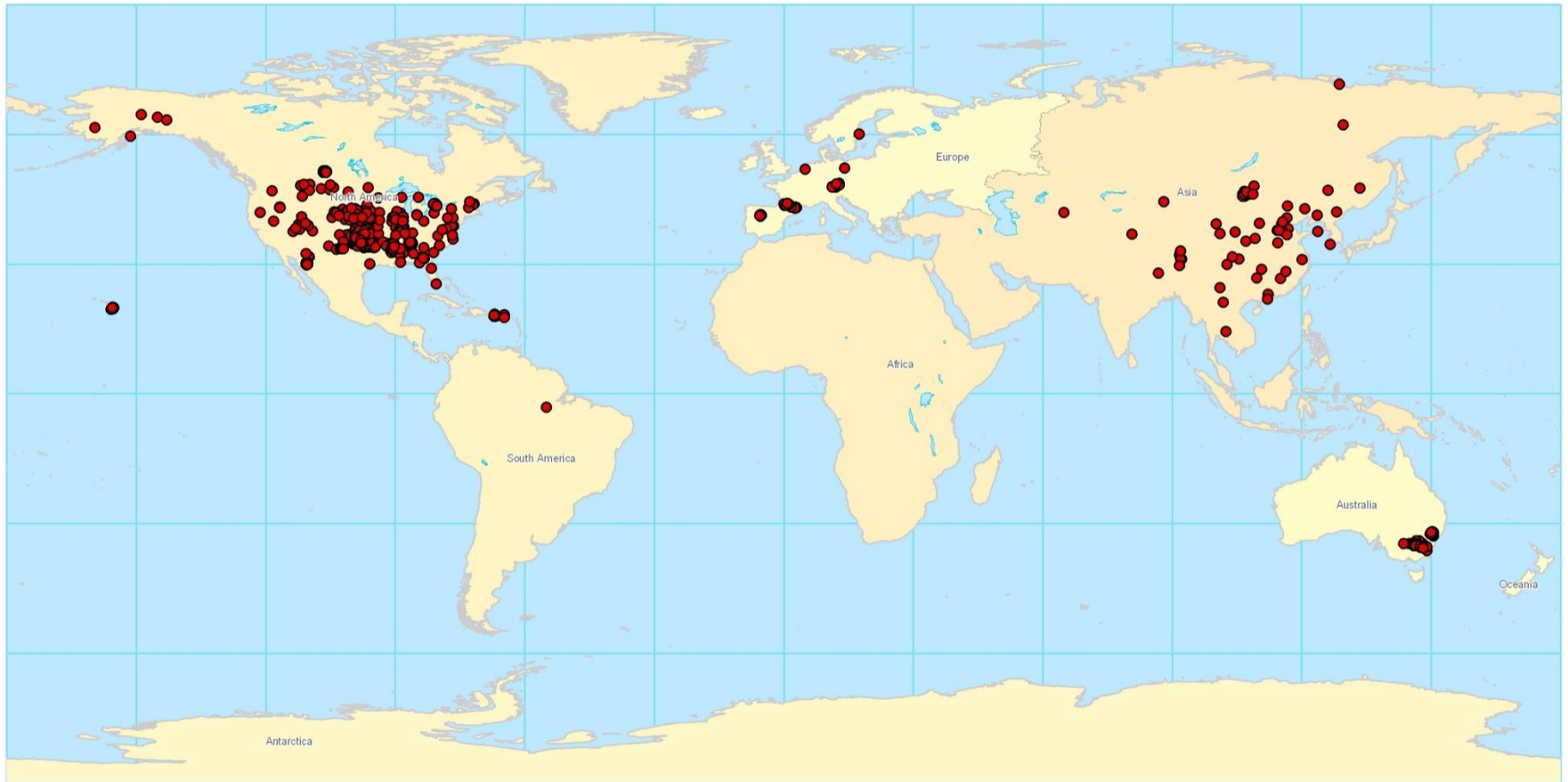
*and*



- Lead Scientist: Michael Cosh (USDA-ARS-Beltsville)
- Local Lead: Tyson Ochsner (Oklahoma State Univ.), Geano Dong
- Field Managers: Chris Stansberry (OSU) and Lynn McKee (ARS)
- Sensor Leads
  - Base Stations: Michael Cosh
  - COSMOS: Marek Zreda (U.Ariz)
  - GPS Reflectometers: Eric Small (Colorado)
  - CRN: Michael Palecki and John Kochendorfer (NOAA)
  - Passive DTS: Susan Steele-Dunne (Delft Univ.), John Selker (Oregon State), Christine Hatch (Umass Amherst), Chadi Sayde (Oregon State), Nick van de Geisen (Delft Univ.)
  - TDR: Steve Evett (USDA-ARS-Bushland) and Tyson Ochsner (OSU)
  - Flux: Jeff Basara (Univ. of Oklahoma) and John Prueger (USDA-ARS-Ames)

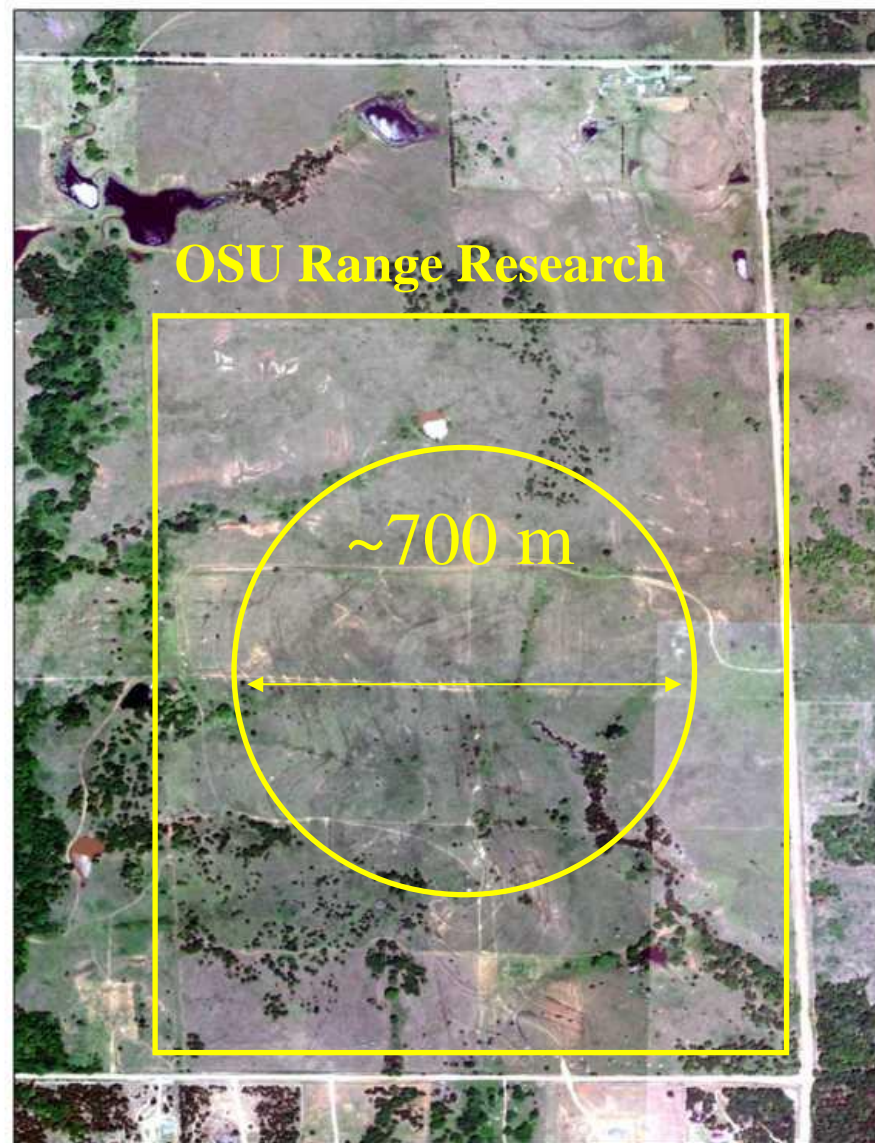


Many in situ networks in the world, with a variety of sensors/methods

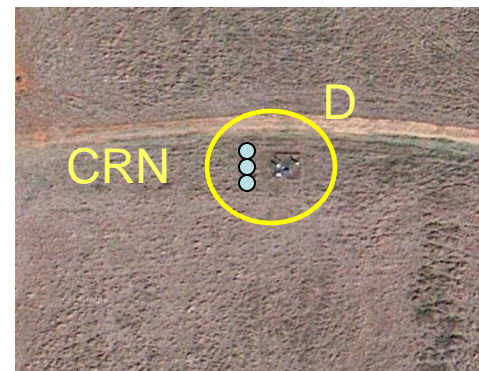
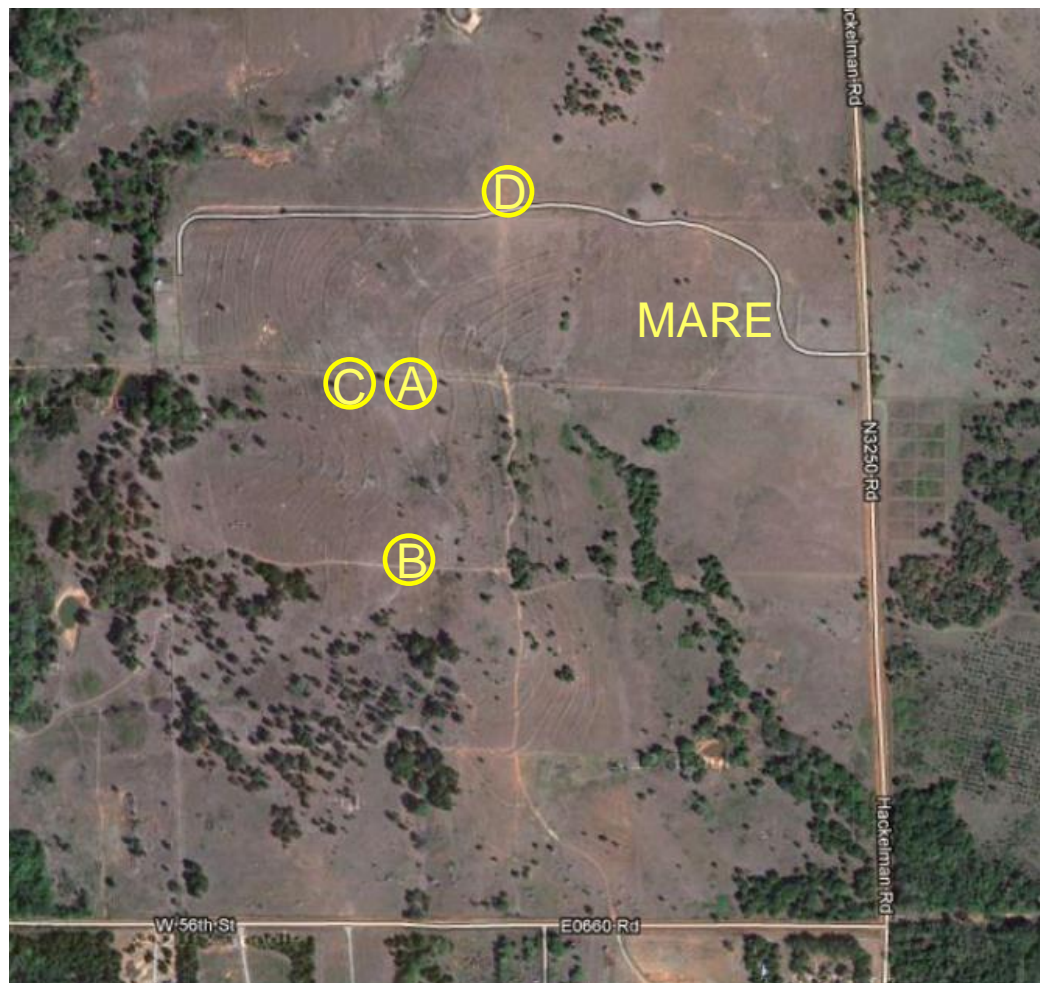




- Managed by OSU Range Research Station
- Local support from OSU Dept. Plant and Soil Science
- Rangeland/Pasture
- Co-located with Oklahoma Mesonet MARE site
- Two NOAA CRN stations nearby (1 additional installed on site)
- Long Term Access ~ 6 years
- >700 m Domain for COSMOS





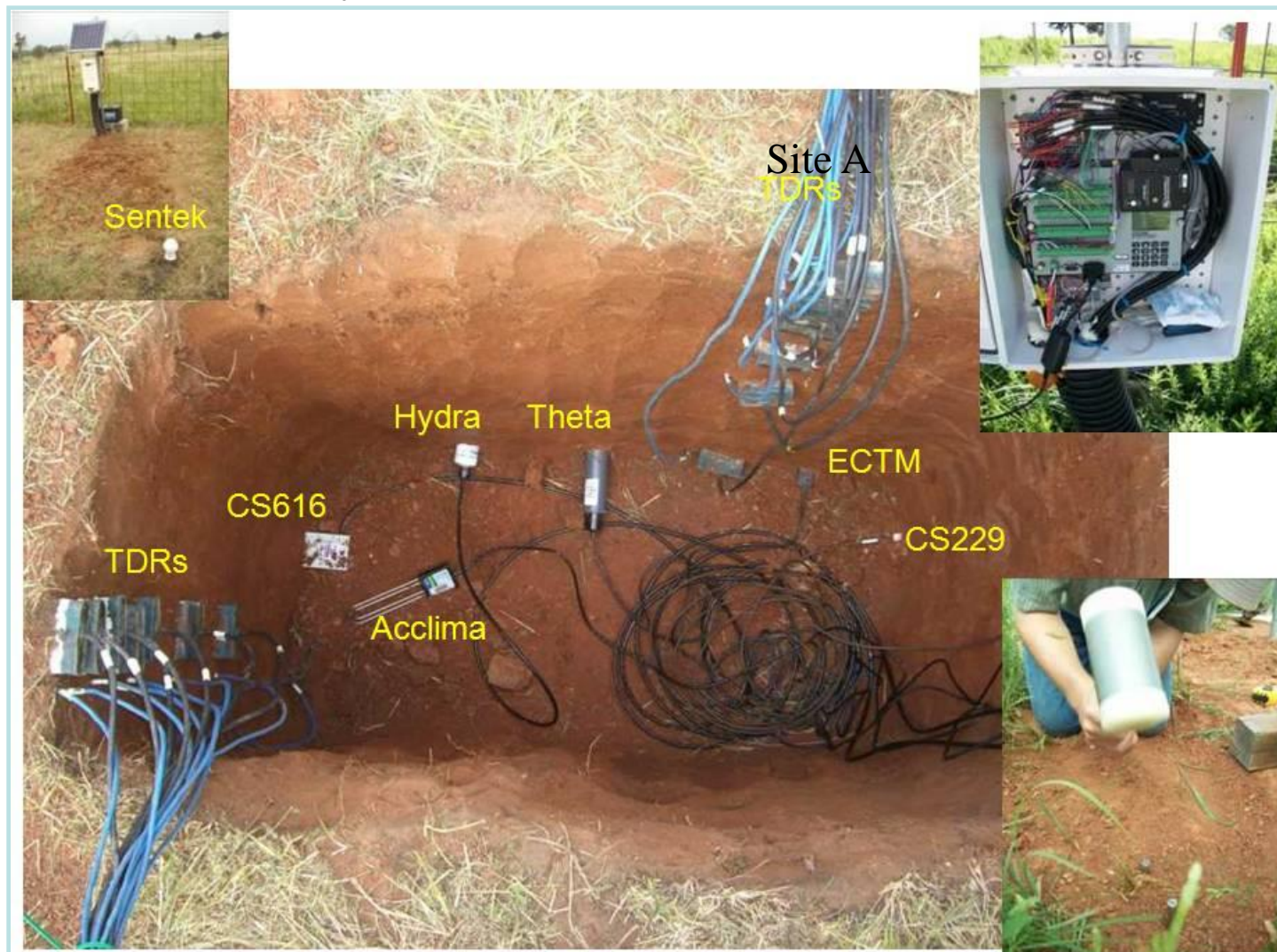


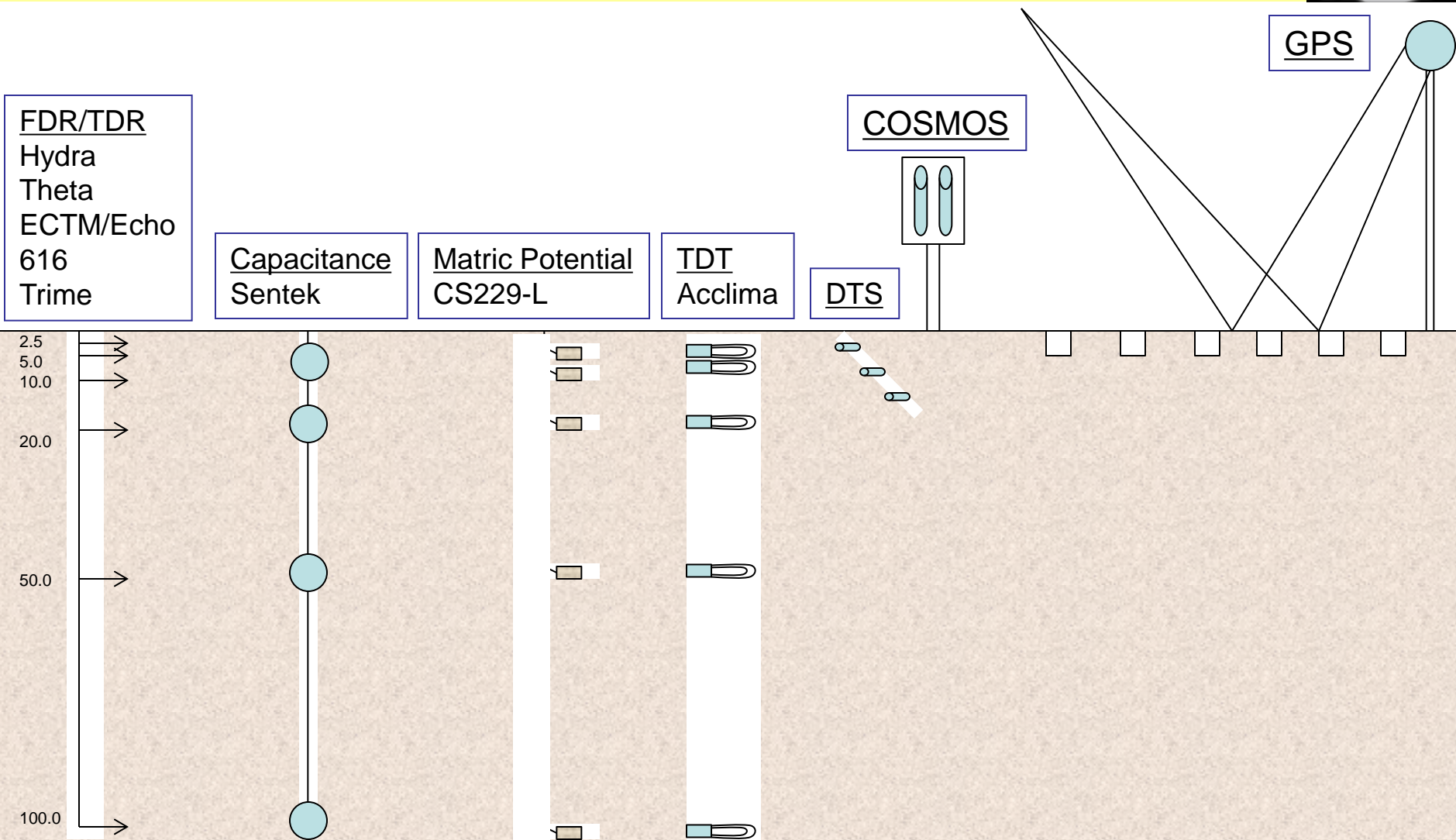
- Four Base Installations
- Common depths of 5, 10, 20, 50, 100 cm, with some sampling at 2.5 cm with Hydra.
- Base station sensors
  - Stevens Water Hydra Probes (6)
  - Delta-T Theta Probes (5)
  - Decagon EC-TM probes (5)
  - Sentek EnviroSMART Capacitance Probes (4)
  - Campbell CS615/CS616 TDRs (5)
  - CS 229-L heat dissipation sensors (OK Mesonet) (5)
  - Acclima Sensor (5)

Site A	Site B	Site C	Site D
Base	Base	Base	Base
GPS	ASSH	GPS	GPS
COSMOS	Passive DTS		CRN
ASSH			
TDR systems			
Flux System			



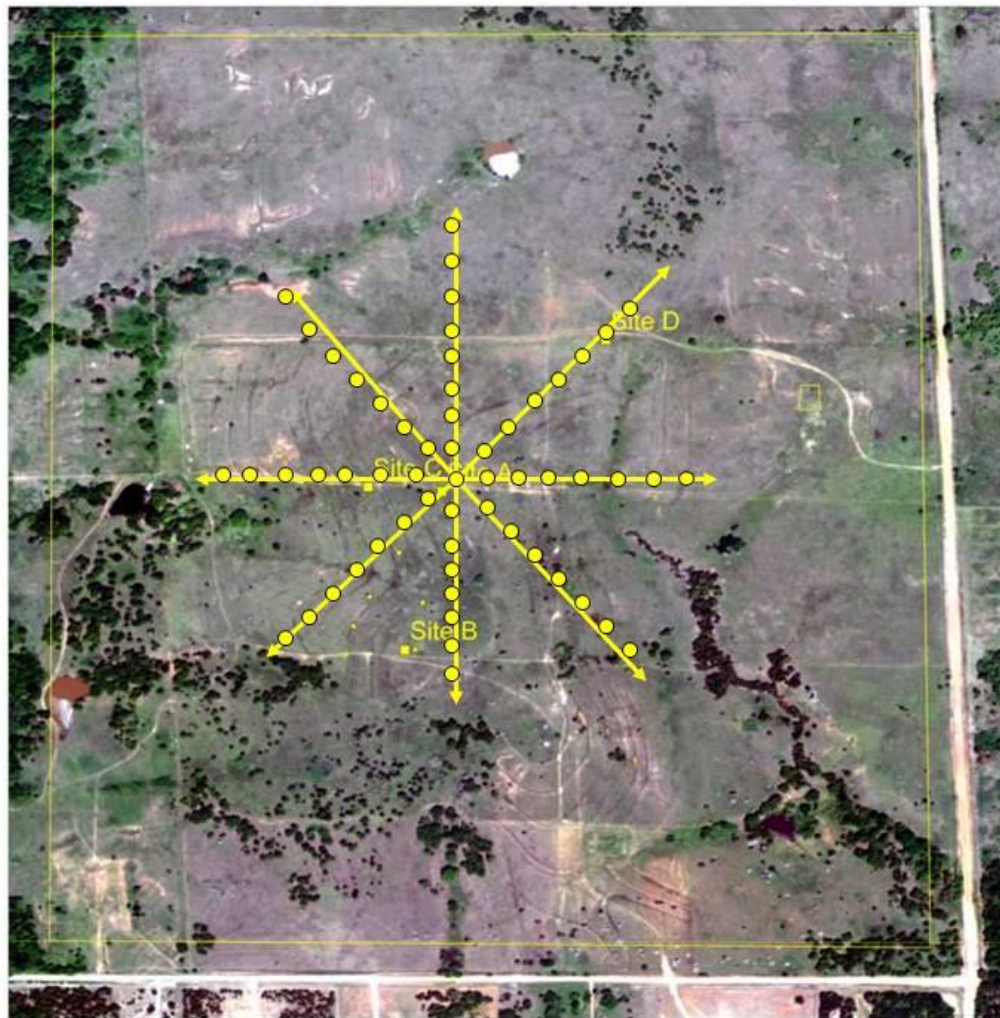
- Installation in May 2010







- Monthly Sampling
  - Vegetation Collection
  - Gravimetric Sampling
  - Theta Probe Sampling
- Intensive Observations
  - High Density Sampling
  - Soil Profiles



- Project Planning begins October 2009
- Installation and deployments
  - Base Stations installed May 2010
  - GPS installed in June 2010
  - COSMOS installed July 2010
  - Passive DTS installed October 2011
  - SMAPVEX11, June 2011, PALS flights/COSMOS rover.
  - Flux Tower installed October 2011
  - Burn Study Winter 2012
  - Additional UAVSAR flights October 2012
  - AirMoss Validation October 2012



## **Soil Calibration**

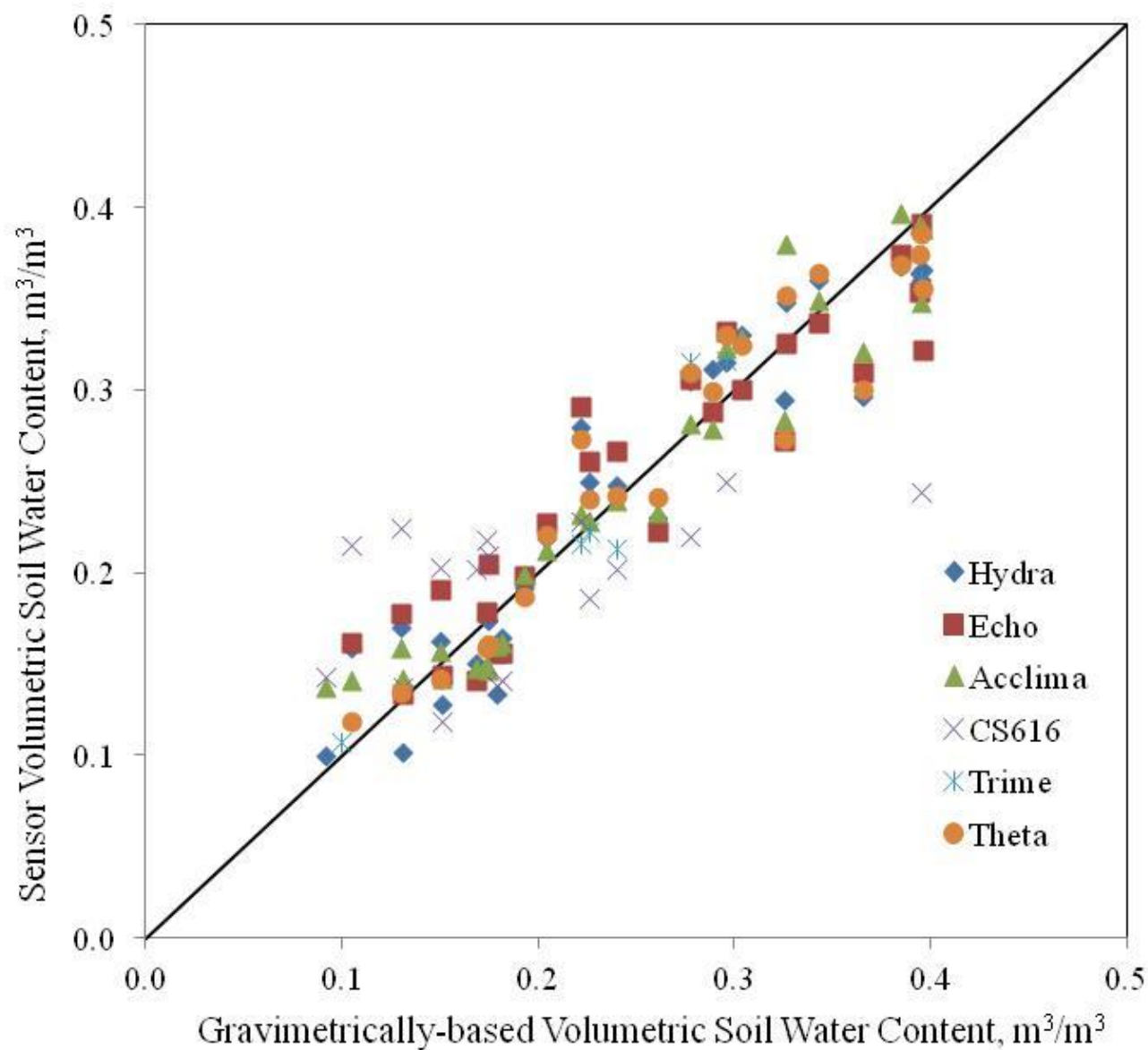
Every sensor can be calibrated to each specific soil to be installed in.

- Soil specific Calibration, in field or in lab with replication of soil bulk density
- Variety of soil moisture conditions necessary for accurate calibration.

## **Installation Scaling**

Each installation should be scaled to determine how it represents the domain in which it is installed.

- Each installation or set of installations is one data series to be calibrated
- Scaling is against the satellite metric, 0-5 cm gravimetrically based volumetric soil moisture.

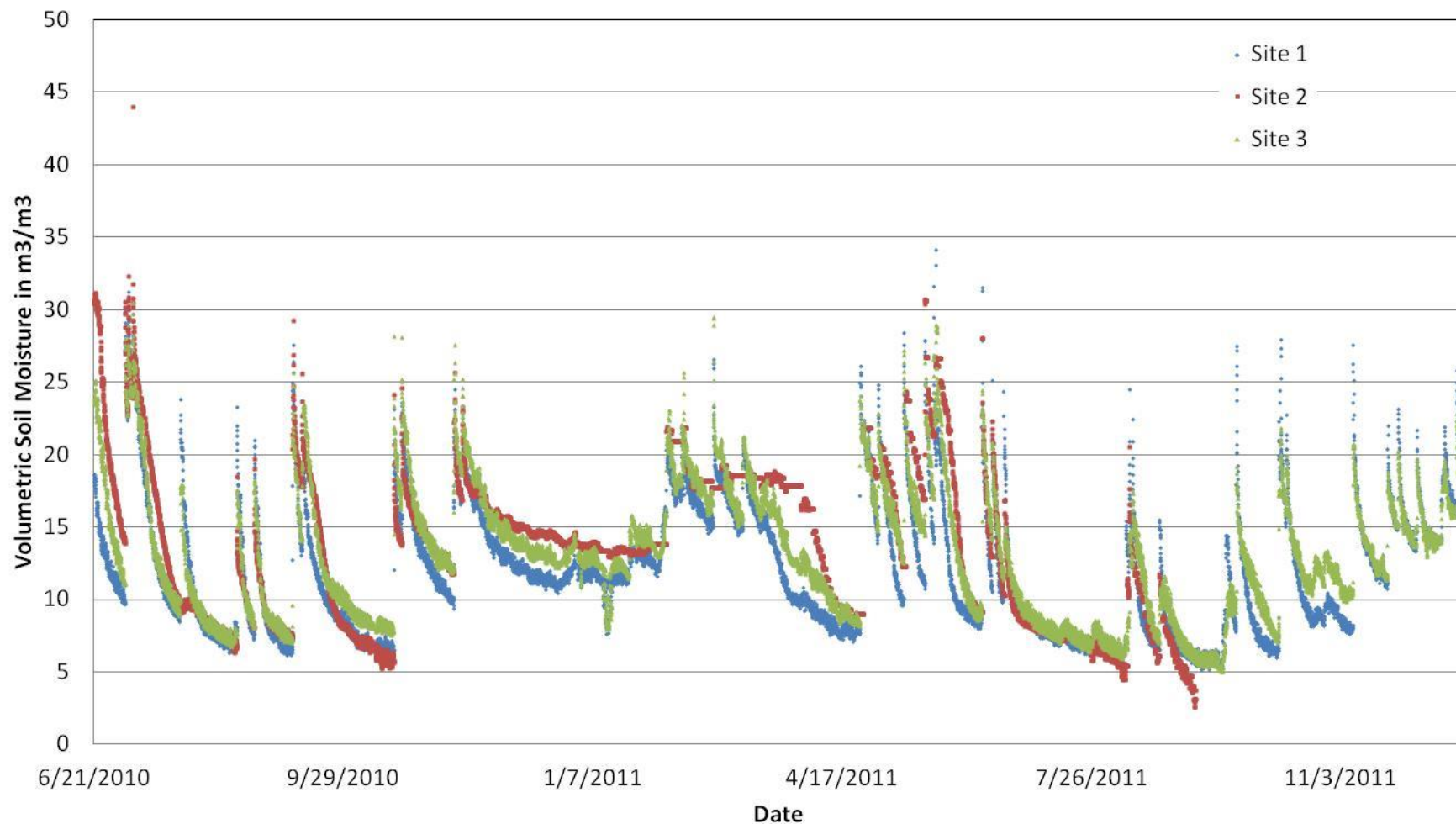




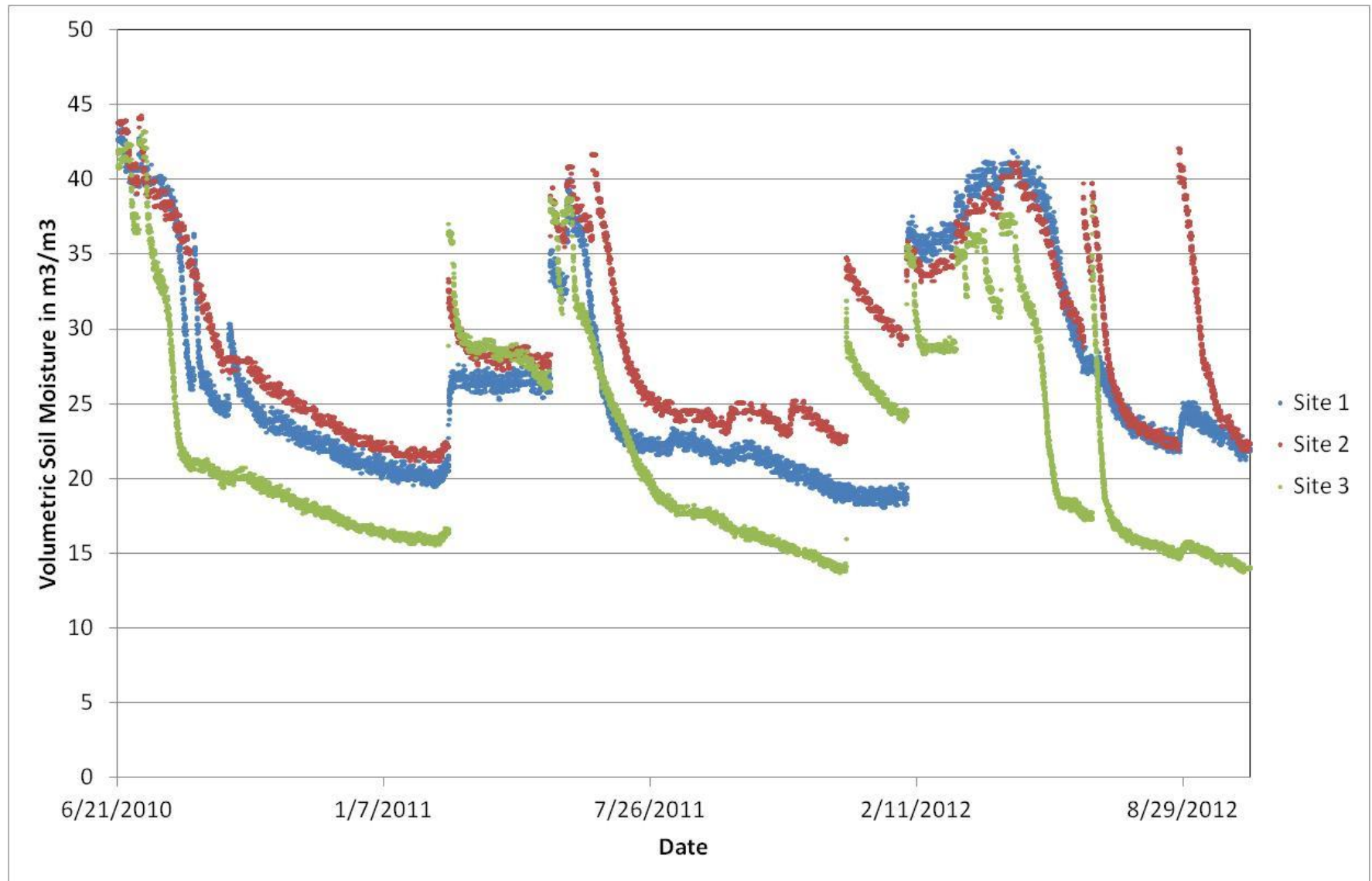
Sensor	RMSE Factory Calibration	RMSE Site Calibration	Failure Rate
Theta	0.0300	0.0276	0% (0/20)
Hydra	0.0401	0.0299	0% (0/24)
ECTM(Echo)	0.0811	0.0361	35% (7/20)
CS616	0.0726	0.0626	5% (1/20)
Acclima	0.0796	0.0253	55% (11/20)
Trime	0.0422	0.0233	12.5% (1/6)
CS229	-	-	15% (3/20)
EnviroSMART/S entek	-	-	0% (0/16)

RMSE in m<sup>3</sup>/m<sup>3</sup>

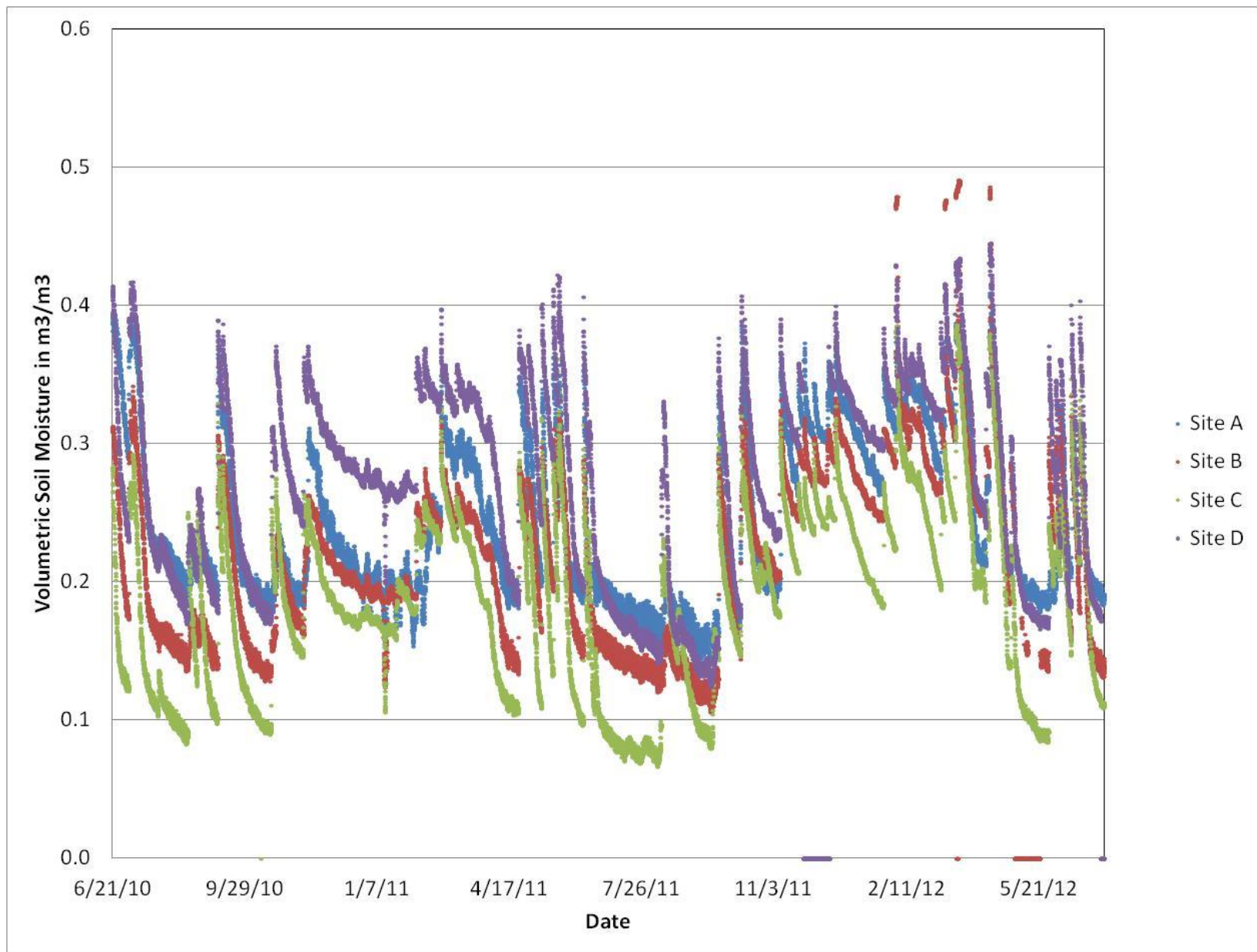
Climate Reference Network at SMAP-MOISST

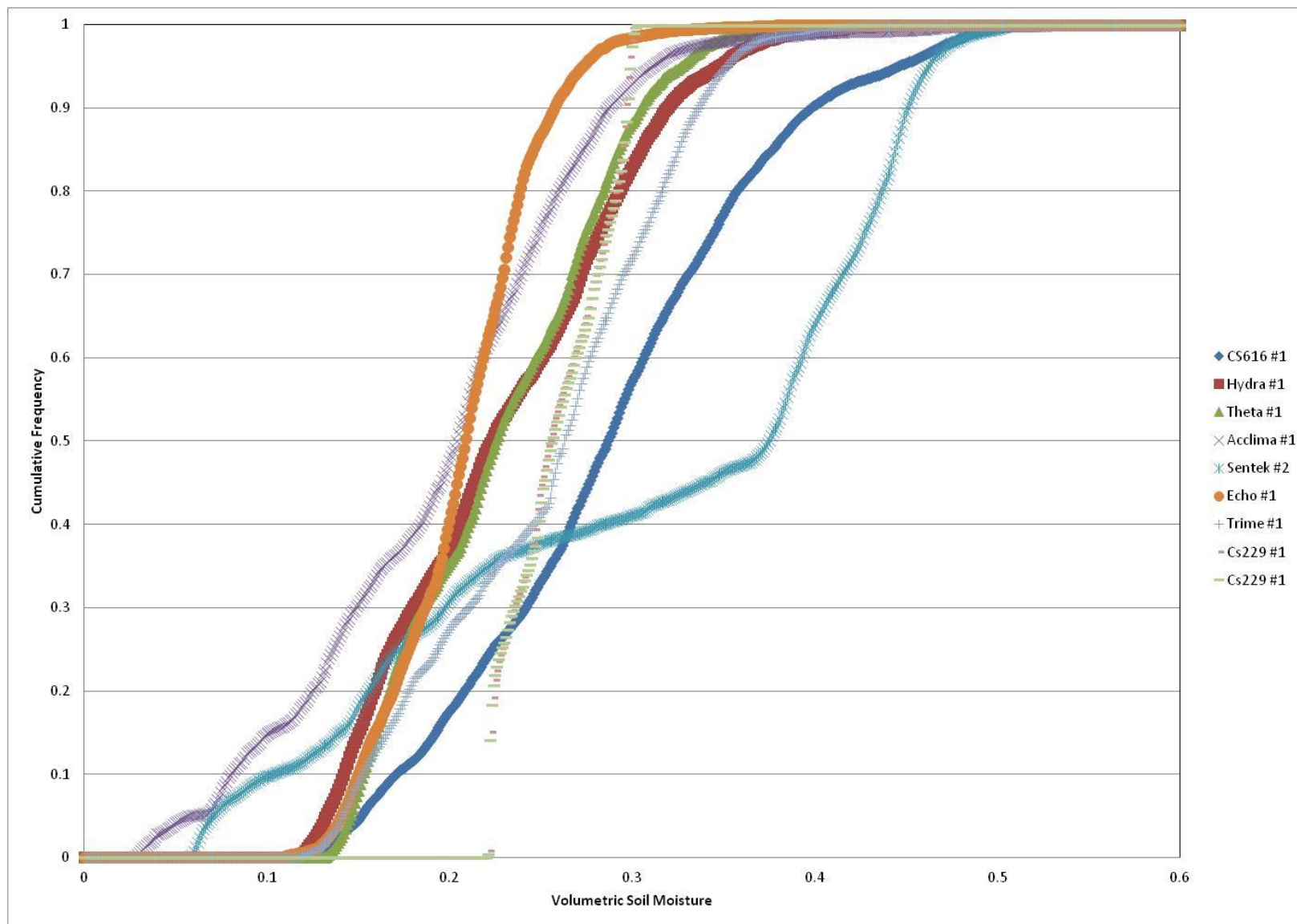




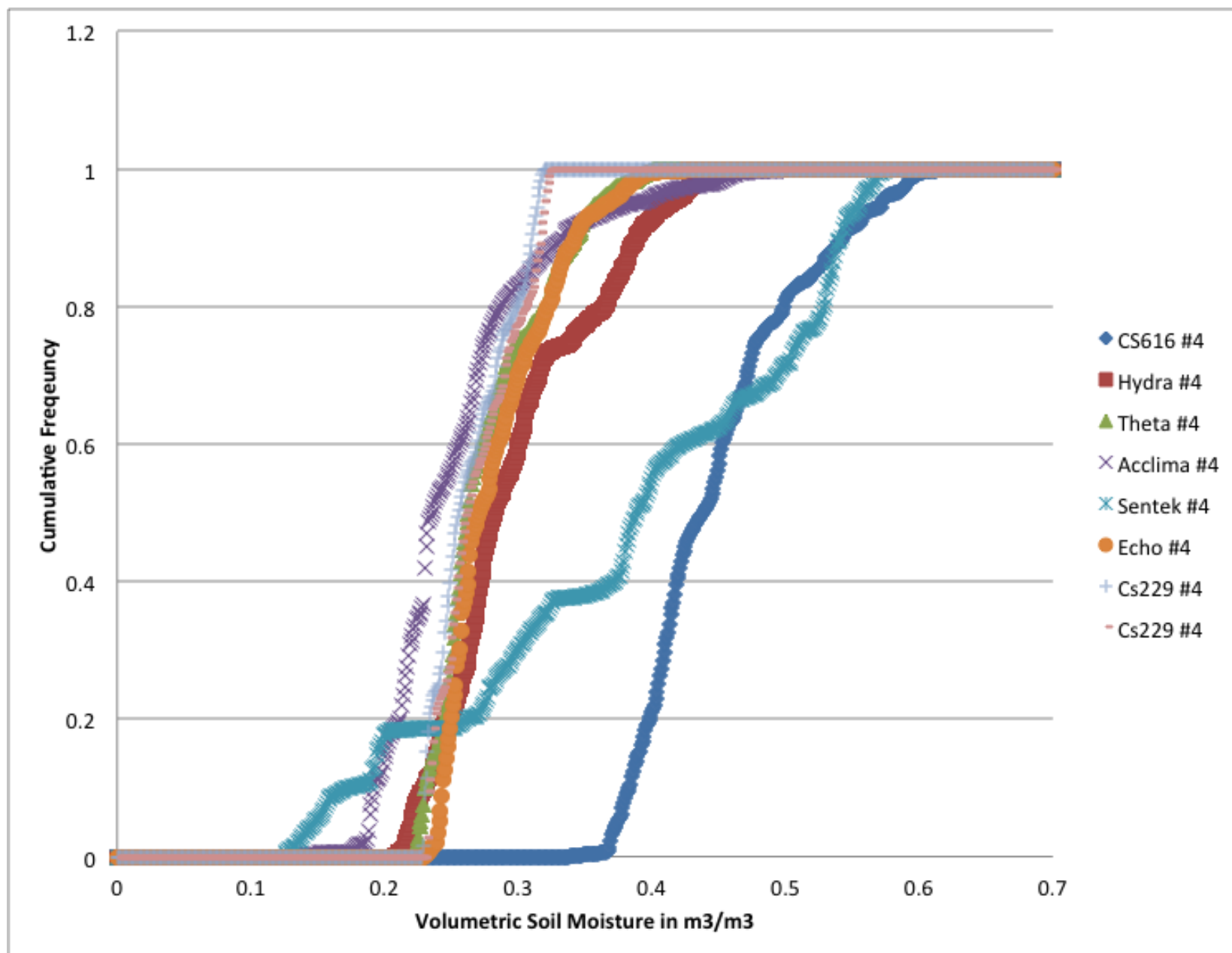


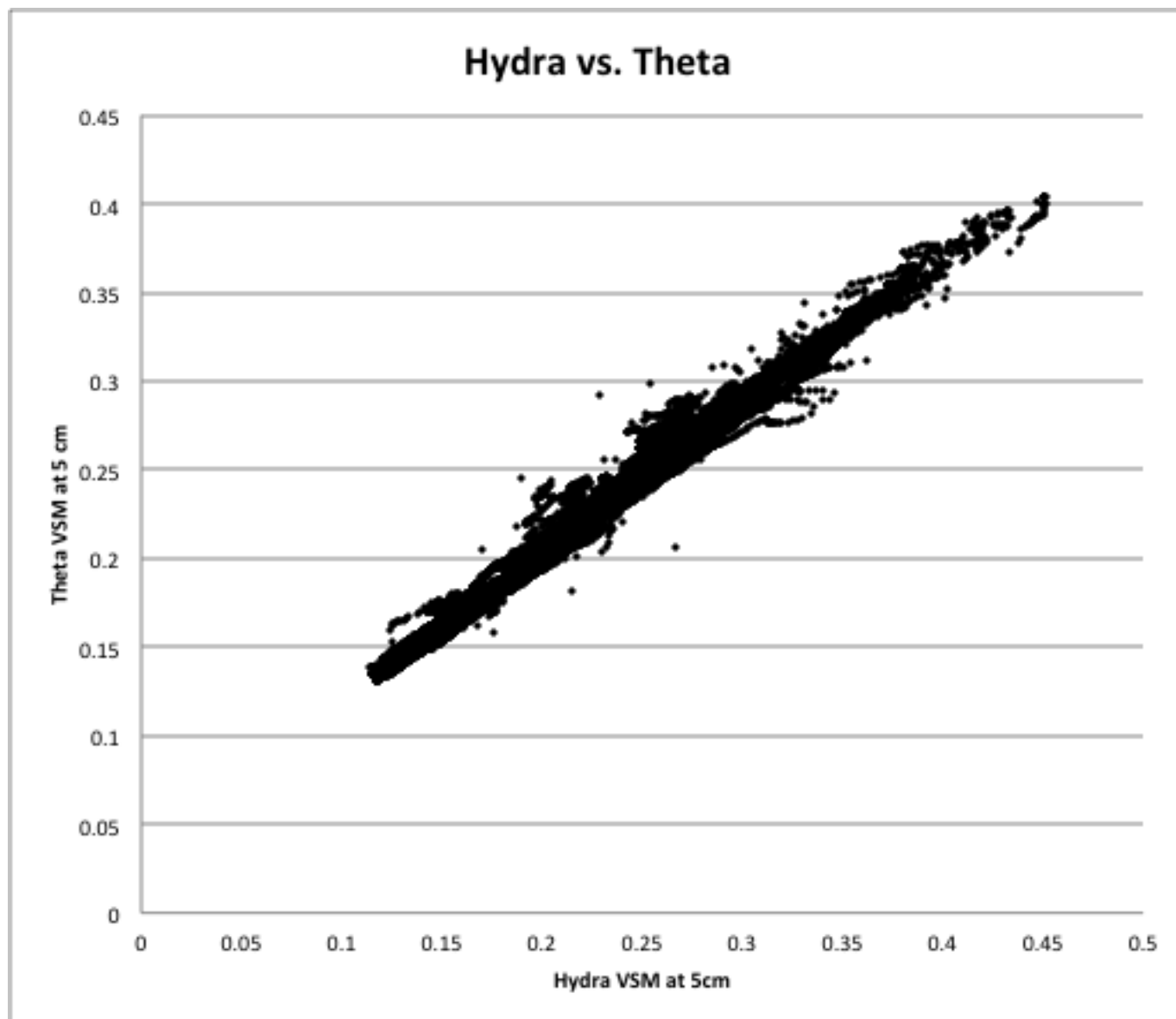
# SMAP Marena Oklahoma In Situ Sensor Testbed Sites A-D Hydras at 5 cm depth

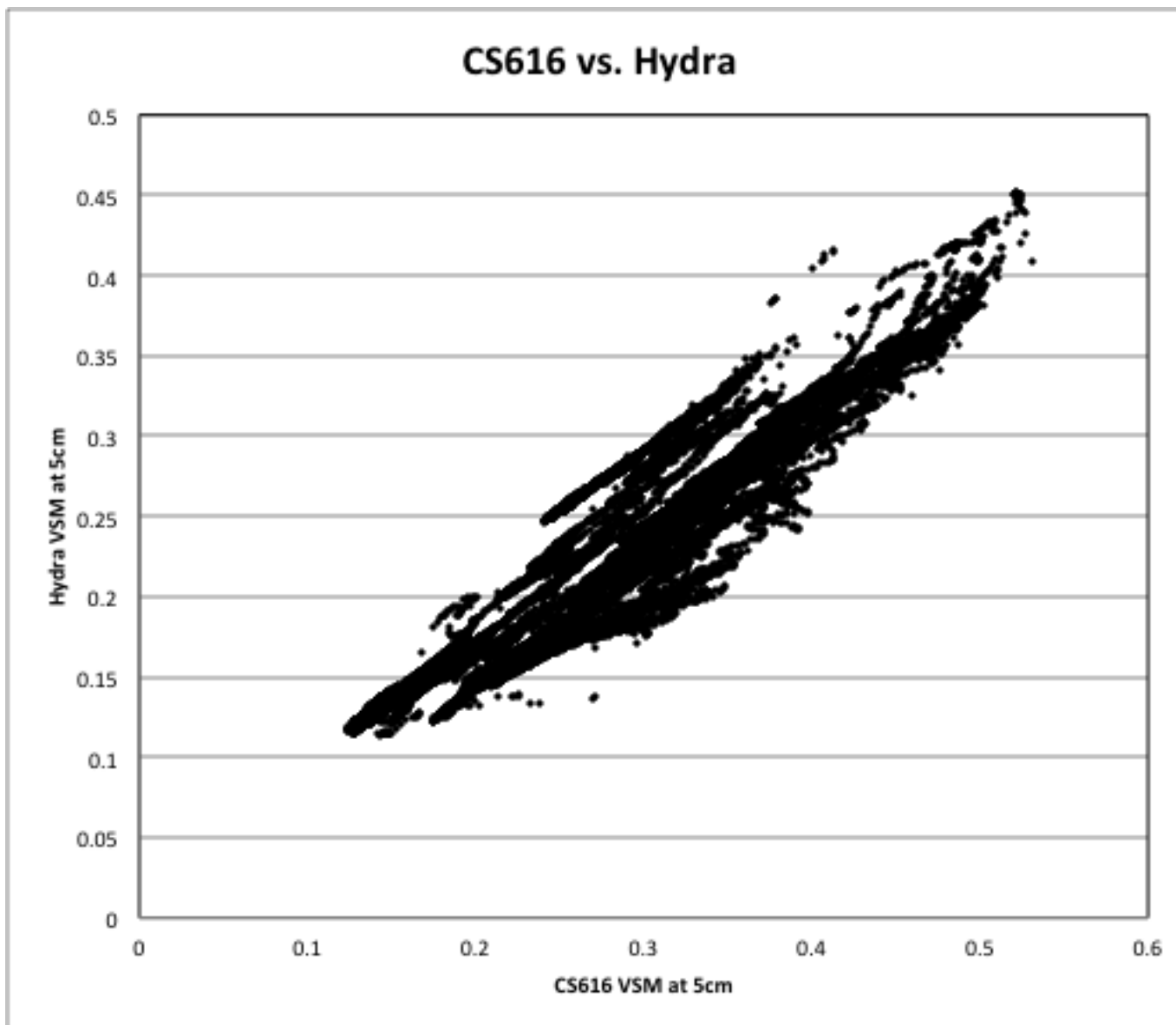




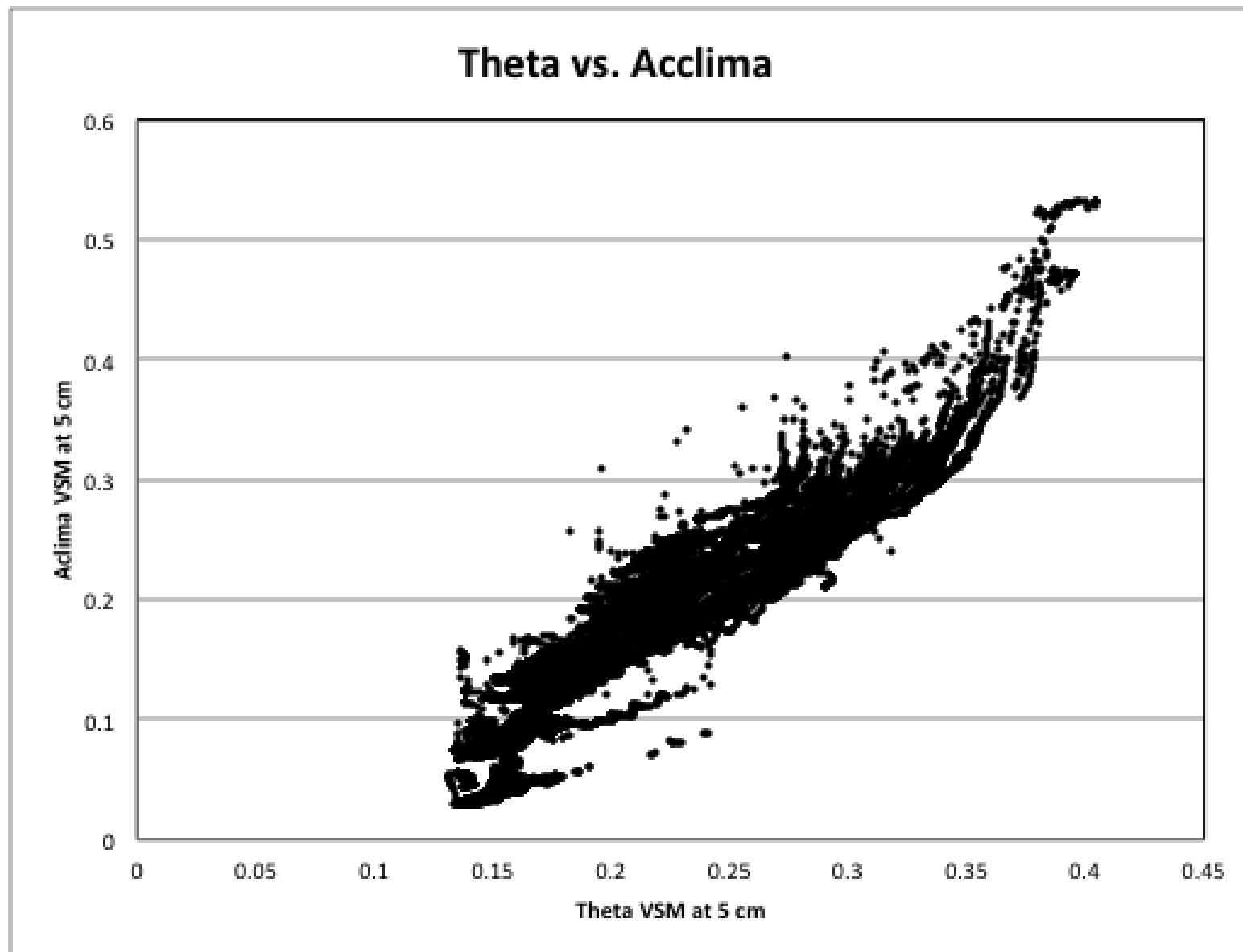




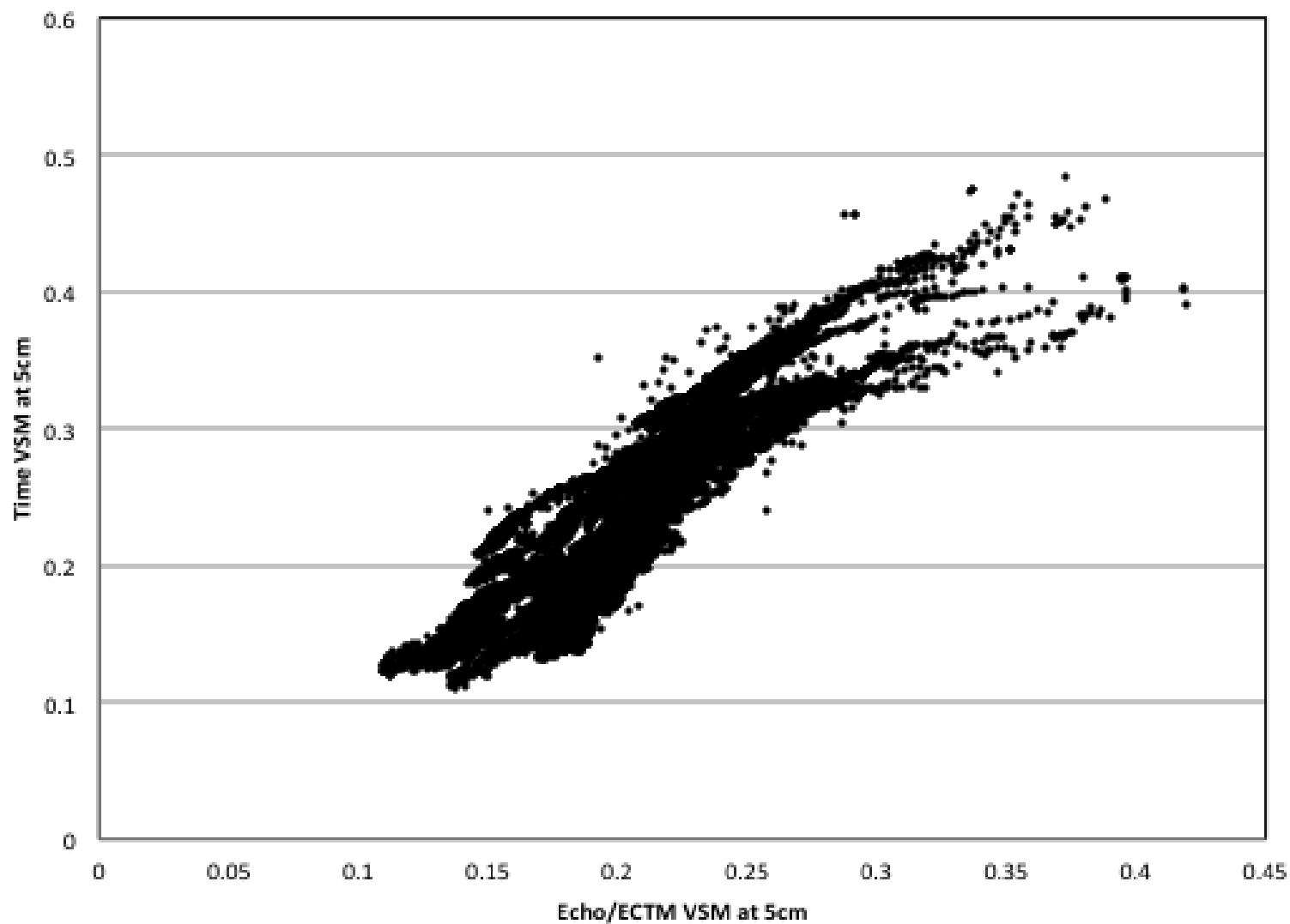


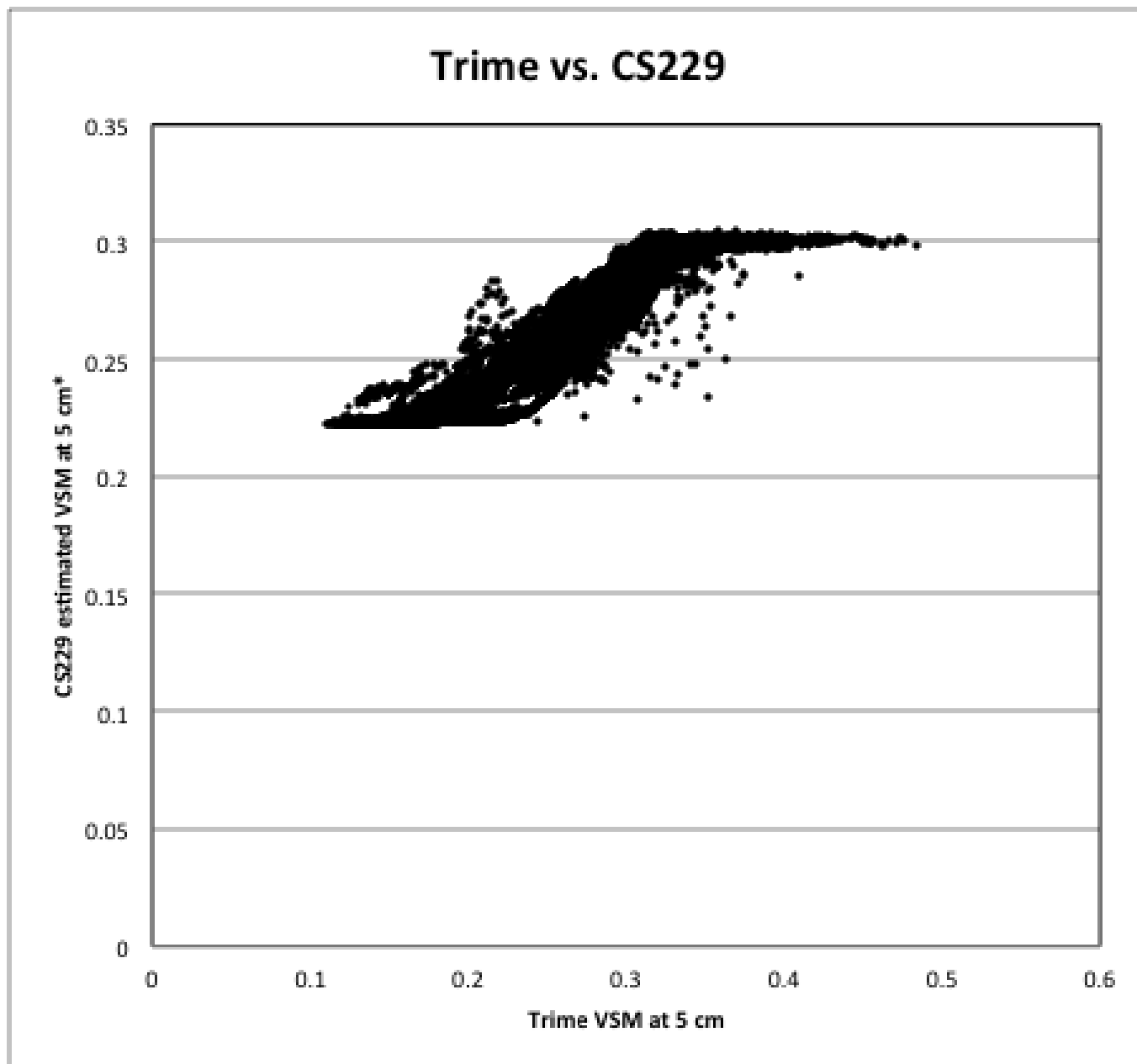




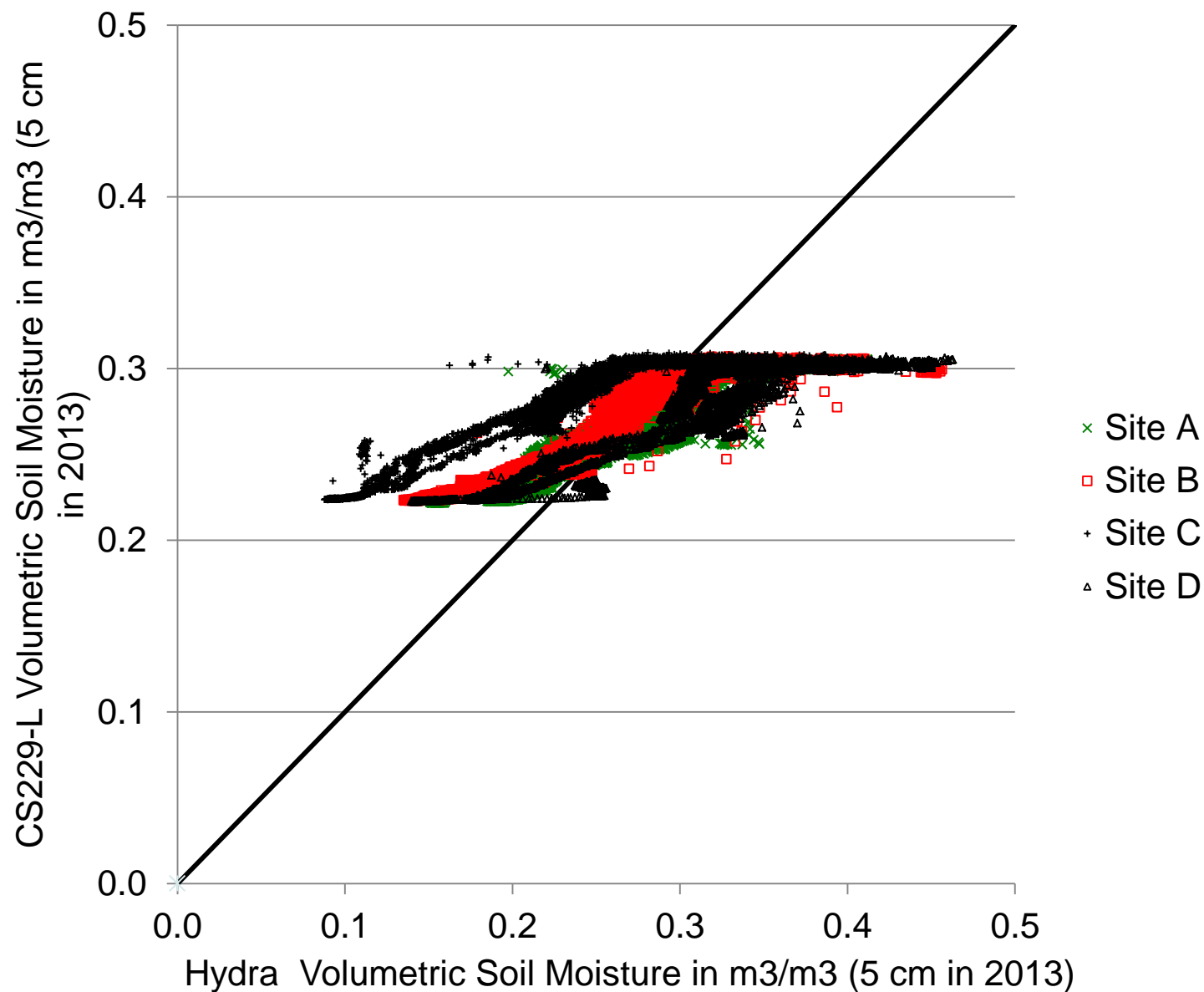


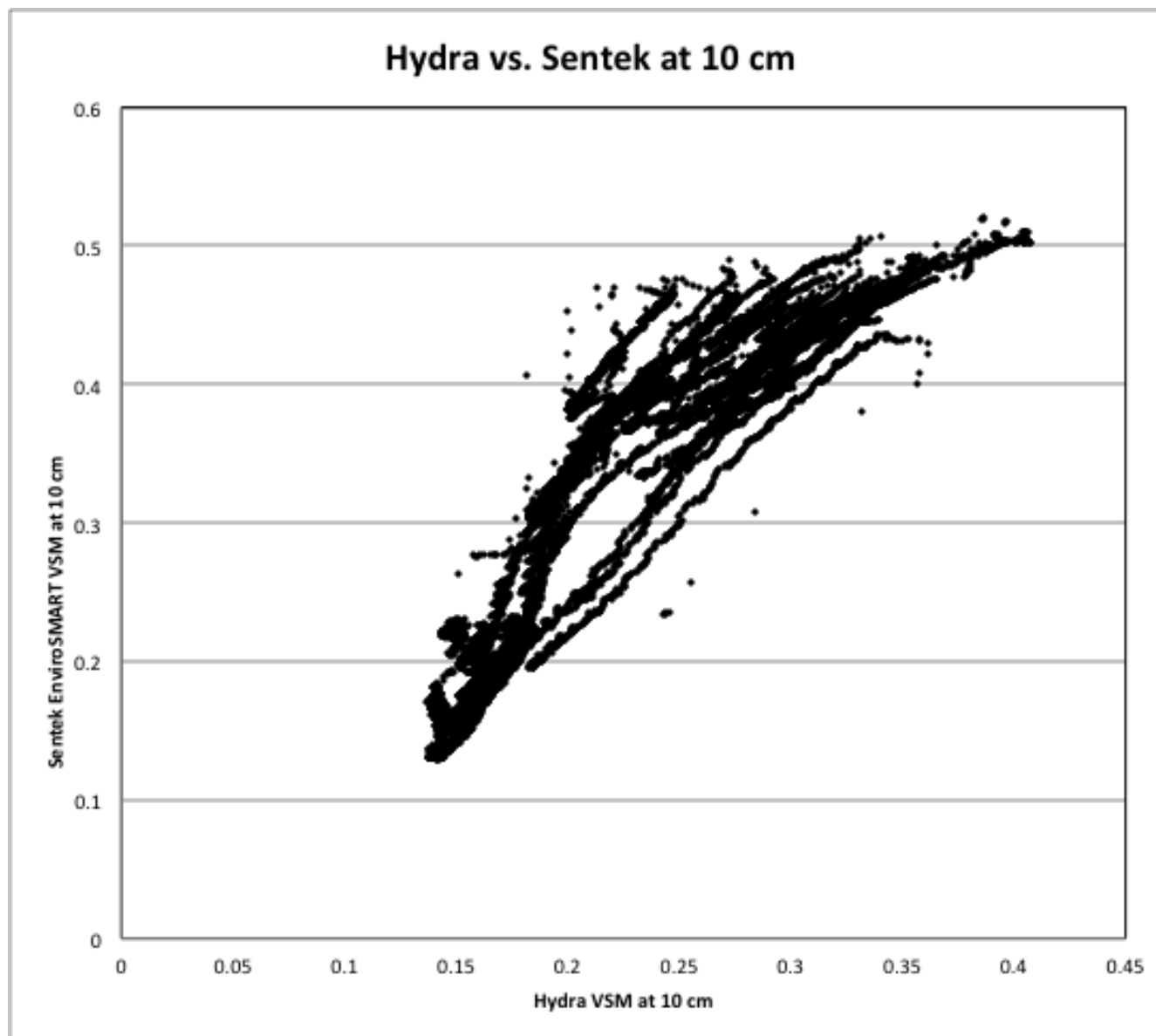
### Echo/ECTM vs. Trime Pico





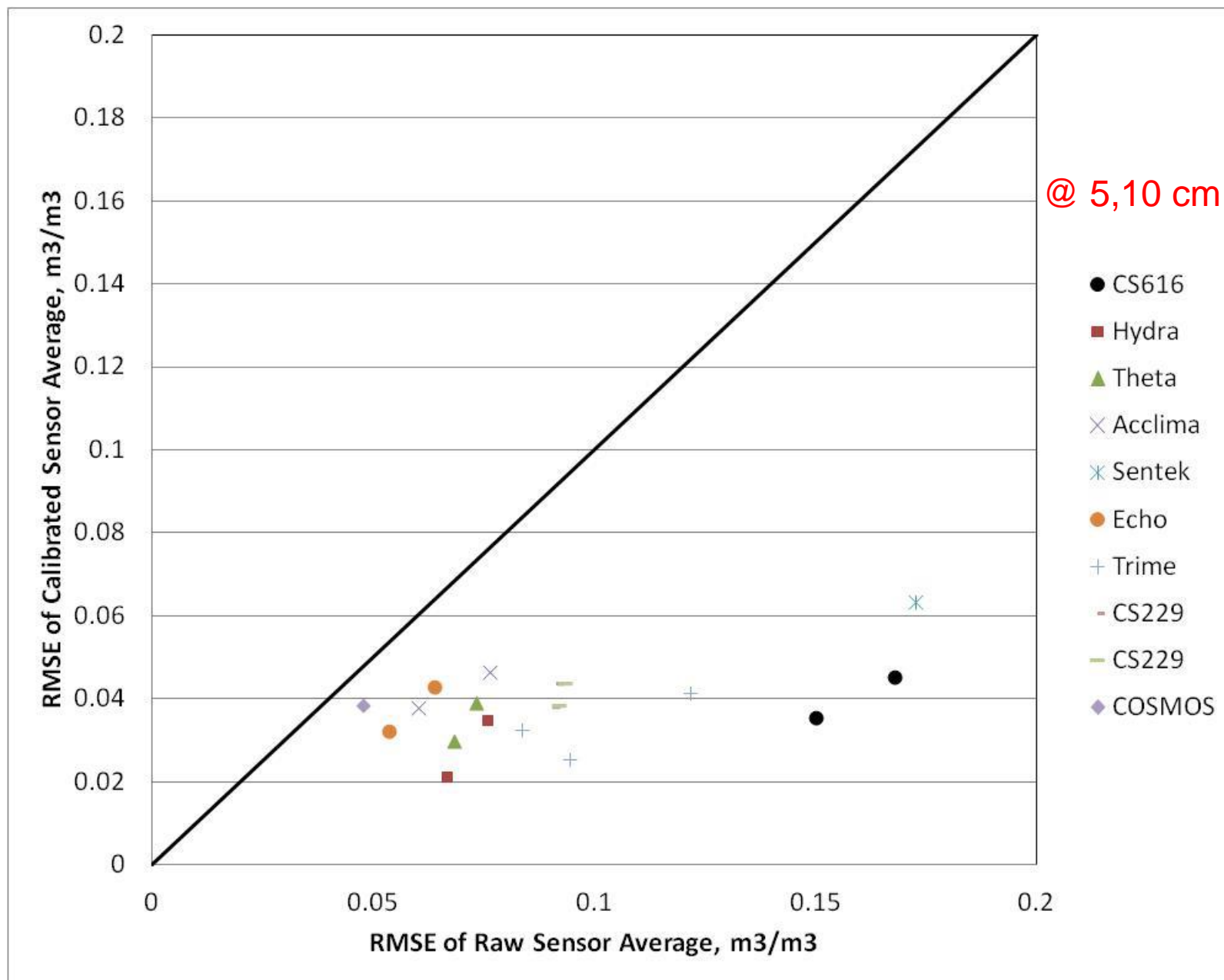






Sensor	2.5 cm	5 cm	10 cm
CS616		0.036	0.046
Hydra	0.21	0.035	-
Theta		0.030	0.039
Acclima		0.038	0.047
Sentek			0.064
Echo		0.032	0.043
Trime	0.0255	0.033	0.042
CS229		0.038	0.044
COSMOS	0.039		





- Installation practices and procedures should be standardized
- Calibration is critical for all sensors.
- Scaling (representativeness) also critical for all sensors.
- Raingage records are important for erroneous readings and troubleshooting.
- Accuracies of  $< 0.04 \text{ m}^3/\text{m}^3$  are achievable with a variety of sensors to field scales.
- Mixing of sensors within or between domains will cause variation at the fringes of the moisture conditions.



# Oops

- We're out of time.

